DOCUMENT RESUME

ED 096 492 CE 002 104

TITLE	Basic Machine Shop--Mathematics; Machine Shop Work--Advanced: 9557.01.
INSTITUTION	Dade County Public Schools, Miami, Fla.
PUB DATE	Jan 73
NOTE	22p.; An Authorized Course of Instruction for the Quinmester Program
EDRS PRICE	MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS	Behavioral Objectives; *Curriculum Guides; *Industrial Education; Mathematical Applications; Mathematics; Secondary Grades; *Shop Curriculum; *Trigonometry
IDENTIFIERS	*Quinmester Program

ABSTRACT

The course outline has been prepared as a guide to assist the student in becoming proficient in trigonomical functions. This aids a machinist in making a complicated set-up so that he can perform a precision machine operation. The guide helps the instructor concentrate on the specific review that will be needed. After the review, the student is taught shop trigonometry related to at least one assigned project. Testing and consistent review is necessary to assure understanding. Prior to entry into this course, the student must display a mastery of the skills indicated in Machine Shop Work 2. This is the first Quinmester course of the second year, consisting of 135 instructional hours. The outline consists of five blocks of instruction subdivided into several units each. A bibliography and a posttest are appended; specific objectives are provided for each unit. (Author/AJ)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

V-180

Course Outline
MACHINE SHOP WORK - ADVANCED - 9557
(Basic Machine Shop - Mathematics)
Department 48 - Quin 9557 01

DADE COUNTY PUBLIC SCHOOLS
DIVISION OF INSTRUCTION • 1973

ED 096492

D A D E C O U N T Y P U B L I C S C H O O L S
1 4 5 0 N O R T H E A S T S E C O N D A V E N U E
M I A M I, F L O R I D A 33132

Course Outline

MACHINE SHOP WORK - ADVANCED - 9557
(Basic Machine Shop - Mathematics)

Department 48 - Quin 9557.01

county office of

VOCATIONAL AND ADULT EDUCATION

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Dr. E. L. Whigham, Superintendent of Schools
Dade County Public Schools
Miami, Florida 33132

January, 1973

Published by the School Board of Dade County

Course Description

9557	48	9557.01	Basic Machine Shop Mathematics
State Category Number	County Dept. Number	County Course Number	Course Title

This quinmester enables the student to review basic machine shop mathematics and to learn the trigonometrical functions of the right triangle. This is to be applied while completing at least one project using the taper attachment on the engine lathe. Safety, theory, and industrial processes are emphasized as the student experiences the correct use of mathematics combined with the machine work. This is the first quinmester course to be taken in the second year of the vocational machine shop course.

Indicators of Success: Prior to entry into this course, the students must display a mastery of the skills indicated in Machine Shop Work II, (9555.01 - 9555.04).

Clock Hours: 135

PREFACE

The following quinmester course outline has been prepared as a guide to assist the student in becoming proficient in trigonomical functions. This aids a machinist in making a complicated set-up so that he can perform a precision machine operation.

The decreasing availability of machinists, due to earlier retirement, has created a demand; especially for the person who can calculate and apply principles to his own shop mathematical problems. This person can readily receive a higher rate of pay. He qualifies to apprentice in a machine shop or in the tool and die trade, and in the future can qualify for a position as a supervisor.

This is a guide for the instructor to concentrate on the specific review that will be needed. After the review, the student is taught shop trigonometry related to, at least, one assigned project. A series of testing and consistent review is necessary to assure understanding.

Methods of teaching will vary and will include lectures, individual and group discussion, reference materials, audio-visual aids and related occupational assignments. Prior to entry into this course, the student must display a mastery of the skills indicated in machine shop Work II, (9555.01 - 9555.04). This is the first quinmester course of the second year, consisting of 135 instructional hours. The outline consists of five blocks of instructions which are subdivided into several units each.

This outline was developed through the cooperative efforts of the instructional and supervisory personnel, the quinmester advisory committee, and the Vocational Curriculum Materials Service and has been approved by the Dade County Vocational Curriculum Committee.

TABLE OF CONTENTS
with Suggested Hourly Breakdown

	Page
PREFACE	1
GOALS	iii
SPECIFIC BLOCK OBJECTIVES	iv
BIBLIOGRAPHY	5
BLOCK	
I. ORIENTATION (14 Hours)	
Student Responsibilities	1
Criteria for Evaluation	1
Familiarization with Shop Equipment, Tools and Materials	1
Course Objectives	1
Student Benefits	1
II. MATHEMATICS REVIEW (21 Hours)	
Basic Arithmetic	2
Basic Algebra Formulas	2
Related Trigonometry	2
III. SHOP TRIGONOMETRY (100 Hours)	
Use of the Table of Natural Functions	2
Right Triangle	2
IV. QUINMESTER POST-TEST	
APPENDIX: QUINMESTER POST-TEST SAMPLE	9

GOALS

The student must be able to demonstrate:

1. Familiarity with shop equipment and materials; regulations regarding school, shop, and safety; and an awareness of the employment opportunities in the machining trades.

2. The ability to set gages and attachments using mathematical calculations.

3. The skills necessary to manufacture an assigned project requiring mathematical calculations.

4. The ability to solve the identities and equations of the right triangle.

5. The application of the table of natural functions in the right triangle.

6. A knowledge of the important role mathematics plays in the machining trades.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - ORIENTATION

The student must be able to:

1. State what action should be taken in regard to shop-incurred injuries.
2. State his responsibility to comply with state and county laws pertaining to all safety regulations and shop fees.
3. Explain methods used by the instructor for evaluation, and be in attendance a minimum of 866 hours during a period of two years, in order to qualify for a 900-hour trade certificate.
4. Determine the employment opportunities available upon completion of minimum course requirements.

BLOCK II - MATHEMATICS REVIEW

The student must be able to:

1. Solve basic arithmetic problems using whole numbers, common fractions, and decimal fractions.
2. Relate the common fractions of an inch to the steel rule and the decimal fractions of an inch to the micrometer and vernier caliper.
3. Calculate the related machine shop mathematical problems from the formulas.

BLOCK III - SHOP TRIGONOMETRY

The student must be able to:

1. Locate the correct answer from the table of natural functions.
2. Solve the unknown length of the sides and the degree of the angles of a right triangle.
3. Complete an assigned shop project requiring shop trigonometry.

BLOCK IV - QUINMESTER POST-TEST

The student must be able to:

1. Satisfactorily complete the quinmester post-test

Course Outline

MACHINE SHOP WORK - ADVANCED - 9557
(Basic Machine Shop - Mathematics)

Department 48 - Quin 9557.01

I. ORIENTATION

A. Student Responsibilities
   1. School policies relative to attendance
   2. Safety regulations
      a. Proper shop clothing
      b. Correct eye protection
      c. Accepted safety practices
   3. Work regulations
      a. Shop fees
      b. Housekeeping
      c. Use and care of equipment
      d. Material and supplies

B. Criteria for Evaluation
   1. Standards
      a. To complete course
      b. To receive certificate
   2. Methods
      a. Related work
         (1) Written
         (2) Oral
         (3) Notebooks
         (4) Textbooks
      b. Manipulative skills
         (1) Projects
         (2) Daily work assignments

C. Familiarization with Shop Equipment, Tools, and Materials
   1. Machine tools
   2. Types of metals
   3. Hand tools
   4. Precision measuring tools

D. Course Objectives
   1. Develop safety consciousness
   2. Encourage cleanliness and orderliness
   3. Develop speed and accuracy
   4. Demonstrate skill and judgment

E. Student Benefits
   1. Development of manipulative skills
   2. Opportunities for employment
      a. Machine operator
      b. General machinist

c. Tool and die maker apprentice
d. Plastic mold maker apprentice
e. Precision inspector

II. MATHEMATICS REVIEW

A. Basic Arithmetic
1. Whole numbers
a. Multiplication
b. Division
2. Common fractions
a. Addition
b. Subtraction
c. Multiplication
d. Division
e. Related to machine shop measurement
3. Decimal fractions
a. Proper placement
b. Related to machine shop measurement

B. Basic Algebra Formulas
1. Tap drill sizes
2. Machine screw gage sizes
3. Machine cutting feeds
4. Machine cutting speeds
5. Sine bar
6. Taper attachment
7. Lathe tailstock set over
8. Revolutions per minute
9. Index head
10. Spur gear
11. Change gear (helix)

C. Related Trigonometry
1. Lathe taper attachment
2. Sine bar

III. SHOP TRIGONOMETRY

A. Use of the Table of Natural Functions
1. Systems of measurement
2. Interpolation
3. Application to the right triangle

B. Right Triangle
1. Formulas for finding functions of angles
a. Sine
b. Cosine
c. Tangent
2. Formulas for finding lengths of sides
a. Side and angle known
b. Two sides known
c. Pythagorean theorem

d. Square root

IV. QUINMESTER POST-TEST

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4. Grinding Cutter Bits. 16 mm. 20 min. Color. Sound. South Bend Lathe Works.

5. Grinding a Parallel Bar. Part I. 16 mm. 14 min. B/W. United World Films, Inc.

6. Hacksaws. 16 mm. 18 min. B/W. Sound. United World Films, Inc.

7. Hammers. 16 mm. 11 min. B/W. Sound. United World Films, Inc.

8. Hand Soldering. 16 mm. 17 min. B/W. Sound. United World Films, Inc.

9. Hardness Testing: Rockwell. 16 mm. 18 min. B/W. Sound. United World Films, Inc.

10. Inspection of Threads. 16 mm. 22 min. B/W. Sound. United World Films, Inc.

11. Metal Working Lathe. 16 mm. 20 min. Color. Sound. South Bend Lathe works.

12. Micrometer. 16 mm. 15 min. B/W. Sound. United World Films, Inc.

13. Milling Machine. 16 mm. 8 min. B/W. Sound. United World Films, Inc.

14. Plain Indexing and Cutting a Spur Gear. 16 mm. 26 min. B/W. Sound. United World Films, Inc.

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A P P E N D I X

Quinmester Post-Test Sample

QUINMESTER POST-TEST I

Name _____ Date _____ Score _____

Multiple Choice Test Items

Each statement needs a word, a figure, or a phrase to make it correct. Only one of the choices listed is correct. Place the number of the choice you make in the space provided at the left edge of the sheet.

____ 1. 3-5/8 divided by two equals
a. 1-15/16
b. 1-13/16
c. 1-5/16
d. 2-13/16

____ 2. 10-3/16 divided by two equals
a. 5-3/32
b. 5-19/32
c. 5-3/16
d. 10-3/32

____ 3. When nine thousandths, seventy-eight one hundredths, and fifteen ten thousandths are added together they equal
a. .0885
b. .8041
c. .804
d. .7905

____ 4. 1-5/8 plus 3-1/16 equals
a. 5-7/8
b. 5-11/16
c. 4-11/16
d. 4-7/8

____ 5. 2-1/4 minus 3/8 equals
a. 1-3/8
b. 1-5/8
c. 1-7/8
d. 1-15/16

____ 6. 7-15/16 minus 3-31/32 equals
a. 3-29/32
b. 3-31/32
c. 3-31/64
d. 4-29/32

____ 7. 3/8 times 1/2 equals
a. 3/16
b. 5/16
c. 7/16
d. 1/16

___ 8. The distance between any two adjacent holes on a piece is 3/4". The distance between the first and fifth holes is
a. 3-3/4"
b. 3/4"
c. 3"
d. 2-1/4"

___ 9. 3125 multiplied by 25 equals
a. 78,125
b. 77,125
c. 79,125
d. 48,125

___ 10. 6713 times 5248 equals
a. 36,229,824
b. 37,229,824
c. 38,229,824
d. 35,229,824

___ 11. .875 times .3125 equals
a. 2.734375
b. .2734375
c. .3734375
d. .02734375

___ 12. .250 times 4 equals
a. 10
b. 1000
c. 1
d. 100

___ 13. A washer has an outside diameter of 3-3/4" and an inside diameter of 1-7/8". The washer's width between the two diameters is
a. 1-7/8"
b. 3/4"
c. 1-3/4"
d. 15/16"

___ 14. 3,354,148 divided by 628 equals
a. 5,341
b. 5,34[illegible]
c. 5,340
d. 5,242

___ 15. A-54 gallon drum of oil is being used in a machine shop at a rate of 1-1/4 gallons per day. The drum will last
a. 43 days
b. 43.2 days
c. 53 days
d. 33.3 days

___ 16. 1.125 divided by 9 equals
a. 1/4
b. 3/16
c. 1/16
d. 1/8

___ 17. The square root of 625 equals
a. 5
b. 125
c. 50
d. 25

___ 18. The square root of 1,282 equals
a. 35.806
b. 35.807
c. 35.805
d. 35.809

___ 19. The tap drill size of a 3-1/4"-4 thread with a 75% thread would be
a. 3-3/16"
b. 3-1/16"
c. 3"
d. 3-1/8"

___ 20. The tap drill size of a 7/8"-14 thread with a 75% thread would be
a. .750"
b. .9375"
c. .687"
d. .8125"

___ 21. The proper outside diameter size for "0" gage is
a. .060"
b. .010"
c. 0"
d. .013"

___ 22. The proper outside diameter size for "8" gage is
a. .164"
b. .190"
c. .146"
d. .187"

___ 23. The amount of tail stock set over for turning a taper of a shaft 12" long with the large end 1-3/8" diameter and the small end 1-1/4" diameter would be
a. 1/8"
b. 1/16"
c. 1/4"
d. 3/16"
(Formula is $\frac{D-d}{2}$)

___ 24. The circumference of a gear is 7.850 and the lead of the helix is 51 inches. The formula is:

$$\frac{\text{Circumference of stock}}{\text{lead of helix}} = \text{tangent of helix angle}$$

The helical angle is
a. 8°54'
b. 8°45'
c. 9°45'
d. 9°54'

___ 25. Ten turns on the indexing head will revolve the work piece 25
a. 180°
b. 45°
c. one-half turn
d. one-fourth turn

___ 26. 6-2/3 turns on the indexing head are needed to mill a complete
a. triangle
b. hexagon
c. square
d. octagon

___ 27. A flagpole is perpendicular to the level ground. A support wire is fastened at a distance 15' from the bottom of the pole to the ground and fastened to the pole at a point 20'high. The length of the support wire is
a. 24 feet
b. 24-1/2 feet
c. 25 feet
d. 25-1/2 feet

___ 28. In a right triangle the hypotenuse is 5" and the side opposite the angle is 2-1/2". The size of the angle is
a. 30°
b. 60°
c. 26°34'
d. 45°

___ 29. A shaft is 1-1/4" in diameter with a taper starting 1" from the end and tapering down to 5/8" diameter. The angle of the taper on one side is
a. 17°20'
b. 17°19'
c. 17°21'
d. 17°18'

___ 30. The cutting speed in SFPM for a steel workpiece 2-1/2" in diameter revolving at 100 RPM in a lathe is approximately
a. 65-1/2
b. 64-1/2
c. 66-1/2
d. 67-1/2
(Formula is: $CS = \frac{D'' \times \pi \times RPM)}{12}$

___ 31. The RPM required for turning a piece of aluminum 1" in diameter at 200 SFPM would be approximately
a. 76.4
b. 764
c. 7640
d. 76
(Formula is: $RPM = \frac{CS \times 12}{D \times \pi}$

___ 32. If the difference in height between the centers of the disks of a 10" sine bar is 6.743", the angle would be
a. 24°42'
b. 24°41'
c. 41°24'
d. 42°24'
(Formula is: Sine of angle = $\frac{\text{Distance}}{\text{Length of sine bar}}$)

___ 33. The angle measured is 56°6' and a 5" sine bar is used. The difference is
a. 4.250
b. 2.750
c. 2.735
d. 4.150
(Formula is: Dimension = Length of sine bar x sine of angle)

___ 34. A piece in an engine lathe is 10" over-all, and the tapered part is 4" long. The small diameter is 2" and the large diameter is 3-1/8". The taper attachment should be set at an angle of approximately
a. 8°
b. 7°
c. 5°
d. 6°
(Formula is: Tangent of angle = $\frac{1/2\ (D-d)}{\text{Tapered length}}$)

Calculate the following three problems by using the proper formula for each. Formulas are: $(P.D. = \frac{N}{P})$ $(N = P.D. \times P)$

$(N = O.D. \times P.-2)$ $(O.D. = \frac{N + 2}{P})$ $(O.D. = P.D. + \frac{2}{P})$

___ 35. A batch of gear blanks measuring 5.100" in diameter was delivered to a milling-machine operator. The blanks are to have 33 teeth and a pitch of 7. The blank size is
a. just right
b. too small
c. too large
d. too short

___ 36. A gear has 36 teeth and a pitch of 6. The pitch diameter must be
a. 6.333"
b. 6"
c. 1.666"
d. 30"

___ 37. The foreman ordered a milling-machine operator to cut 24-pitch teeth in a blank that measured 3-1/2" in diameter. The job was finished and the number of teeth was
a. 48
b. 82
c. 77
d. 79

___38. Two sides of a triangle 6" and 4" long join to form a right angle. The length of the hypotenuse is
a. 7.810"
b. 7.812"
c. 7.825"
d. 8.710"

___ 39. The one angle of a right triangle is 30° and the side opposite that angle is 7" long. The length of the hypotenuse is
a. 35
b. 3.5
c. 10
d. 14

___ 40. The natural value of an angle with a cosine of 78°9' must be
a. .20982
b. .0218
c. .20535
d. .97869

ANSWER KEY TO QUINMESTER POST-TEST

1.	b	21.	a
2.	a	22.	a
3.	d	23.	b
4.	c	24.	b
5.	c	25.	d
6.	b	26.	b
7.	a	27.	c
8.	c	28.	a
9.	a	29.	c
10.	d	30.	a
11.	b	31.	b
12.	c	32.	d
13.	d	33.	d
14.	a	34.	a
15.	b	35.	c
16.	d	36.	b
17.	d	37.	b
18.	c	38.	a
19.	c	39.	d
20.	d	40.	c